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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1092

TASK ASSIGNMENT NPG-Re3f-650-1-52

FINAL Report

GUN FIRING TEST OF WARHEAD,
SEMI ARMOR PIERCING 3000 LB. TI FOR MATADOR

FINAL Report

Copy No. 12

Task
Assignment NPG-Re3f-650-1-52

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NPG REPORT NO. 1092

Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

PART A

SYNOPSIS

1. Five (5) Warheads, SAP, 3000 lb. T1, for Matador were submitted to Naval Proving Ground for ballistic test and evaluation of homogeneous steel armor penetration properties.
2. It is concluded that:
 - a. The inert loaded Warhead, SAP, 3000 lb. T1 for Matador, fired at 1100 f/s striking velocity and 20° obliquity will penetrate nominal 2-1/4" homogeneous steel armor and remain in effective condition.
 - b. At the same velocity and 0° or 20° obliquity, the warhead will fail against nominal 3-1/4" homogeneous steel armor.
 - c. Failure of the warhead to penetrate the targets is attributed to the welds. In all cases, failure occurred at or originated at a weld.
 - d. From the test results, the employment of a weldment as a SAP warhead appears to be impractical.

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Semi Armor Piercing 3000 lb. T1 for Matador

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Semi Armor Piercing 3000 lb. T1 for Matador

PART B

INTRODUCTION

1. AUTHORITY:

This test was conducted in accordance with references (a) and (b) as authorized by reference (c) and continued under reference (e).

2. REFERENCES:

- a. CHORD, Dept. of Army Conf ltr OO.471.94/163^o(C)ORDTM - Record J. W. Moseman/trr/4587 of 21 Dec 1949
- b. BUORD Conf ltr S75-1(42) (Re3f-MX-771)EJHL:fml Ser 5158 of 17 Jan 1950
- c. BUORD Conf ltr NP9 Re3f-EJHL:fml of 14 Mar 1950
- d. BUORD Conf ltr Re3f-EJHL:fml S75-1(42) Ser 12999 of 17 Oct 1950
- e. BUORD Conf ltr NP9 Re3f-EJHL:am Ser 24428 of 15 Aug 1951

3. OBJECT OF TEST:

The tests were conducted to determine the maximum homogeneous armor plate thickness that the Warhead, SAP, 3000 lb. T1 for Matador would penetrate at 20° obliquity and 1100 f/s striking velocity and remain in an effective condition.

4. PERIOD OF TEST:

- | | |
|---------------------------|------------------|
| a. Date of Project Letter | 14 March 1950 |
| b. Date Tests Commenced | 21 July 1950 |
| c. Date Tests Resumed | 13 February 1952 |
| d. Date Test Completed | 21 February 1952 |

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NPG REPORT NO. 1092

Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

PART C

DETAILS OF TEST

5. DESCRIPTION OF ITEM UNDER TEST:

Warhead, SAP, 3000 lb. T1 for Matador was manufactured for the Army by the A. O. Smith Corp. and submitted for test with details of modification for gun firing as shown by Department of the Army Dwgs. TAM 3009 and TAM 3011. This modification did not stand up for gun firing and after the first test, the four (4) remaining warheads were sent to the Naval Gun Factory under reference (d) for remodification as shown by Department of the Army Dwgs. TAM 3090 and TAM 3091.

6. DESCRIPTION OF TEST EQUIPMENT:

- a. Gun: 24" Smooth Bore, Type A Mod O, No. 235
- b. Propellant: 5"/38 Smokeless Powder SPDN 9830 plus
Black Cannon Powder
- c. Targets: Various thicknesses of homogeneous armor plate

7. PROCEDURE:

Five (5) Warheads, SAP, 3000 lb. T1 for Matador were inert loaded with vermiculite-cement of specific gravity 1.62. These warheads were fired from a 24" smooth-bore gun against homogeneous steel armor plates of thicknesses from 2 1/4" to 4 1/2". The target plates were set at 0° and 20° obliquity. The armor targets were backed by a large sandpile which was used as a recovery medium. Each warhead was recovered and examined prior to firing the next round. Representatives of Bureau of Ordnance and the Department of the Army were consulted before firing each round to determine target thicknesses and test conditions.

8. RESULTS AND DISCUSSION:

The ballistic data are given in detail on Tables II through VI, Appendix (B), and are summarized in Table I, Appendix (A). The bronze bourrelet rings on the warhead as originally submitted for test broke down in the gun. The gun was damaged by scraping and gauging and the warhead struck the target plate at a large yaw angle. The test was considered invalid and the remaining warheads were sent to the Naval Gun Factory for a further modification of the bourrelet

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NPG REPORT NO. 1092

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Semi Armor Piercing 3000 lb. T1 for Matador

rings to make them suitable for gun firing. Upon the return of the warheads from the Naval Gun Factory, testing was resumed. Round 2 was fired against 4"06 armor at 872 f/s striking velocity and 20° obliquity. The warhead was rendered ineffective by this test, the forward nose section being broken off at the weld and the ogival after nose section cracked longitudinally back to and partially around the second circumferential weld. Round 3 was fired against 3"25 armor at 1164 f/s striking velocity and 20° obliquity. This warhead was ineffective and in practically the same condition as Round 2. Round 4 was fired against 2"19 armor at 1107 f/s striking velocity and 20° obliquity. This warhead was effective with no deformation. At the request of the Army representatives, Round 5 was fired against 3"25 armor at 0° obliquity and 1104 f/s striking velocity. This warhead was ineffective being cracked open at the weld ground, the forward nose section and cracked longitudinally back to and partially around the circumferential weld.

PART D

CONCLUSIONS

9. It is concluded that:

a. The inert loaded Warhead, SAP, 3000 lb. T1 for Matador, fired at 1100 f/s striking velocity and 20° obliquity, will penetrate nominal 2-1/4" homogeneous steel armor and remain in effective condition.

b. At the same velocity and 0° or 20° obliquity the warhead will fail against nominal 3-1/4" homogeneous steel armor.

c. Failure of the warhead to penetrate the targets in an effective condition is attributed to the welds. In all cases failure occurred at or originated at a weld.

d. From the test results, the employment of a weldment as a SAP warhead appears to be impractical.

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Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

The tests upon which this report is based were conducted by:

W. W. MEYERS, Plate Battery Officer
Terminal Ballistics Department

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E. A. RUCKNER
Captain, USN
Ordnance Officer
By direction

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NPG REPORT NO. 1092

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Final Report

on

Task Assignment NPG-Re3f-650-1-52

Final Report

on

Gun Firing Test of Warhead

Semi Armor Piercing 3000 lb. T1 for Matador

Project No.: NPG-Re3f-650-1-52
Copy No.: 12
No. of Pages: 6

Date: FEB 28 1953

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TABLE I

SUMMARY OF TEST CONDITIONS AND RESULTS

Test Date	Impact No.	Target thickness inches	Target obliquity degrees	Striking Velocity		Pressure tons per square inch	Penet.	Through Opening
				Des.	Act.			
7/21/50	34972	4.06	20	1000	773	2.8	-	---
Warhead broke up in gun-Gun damaged-Plate pushed from butts by yawed warhead.								
2/13/52	39640	4.06	20	1100	872		C	21" x 46"
Warhead not effective-Nose section broken off at weld-Body cracked open to and broken open at weld aft of the ogive section.								
2/15/52	39654	3.25	20	1100	1164	3.6	C	22" x 33"
Warhead not effective-Nose section broken off at weld-Bomb body cracked open to and broken open at weld aft of ogive section.								
2/19/52	39656	2.19	20	1100	1107	3.8	C	23" x 24-1/2"
Warhead effective and intact-No deformation.								
2/21/52	39682	3.25	0	1100	1104	-	C	22" x 23"
Warhead not effective-Cracked around weld at nose section-Cracked longitudinally back to forward support band.								

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APPENDIX A

File No.

Butt Firing

U. S. Naval Proving Ground

Dahlgren, Va.

194

IMPACT NO. 34972IMPACT DATE 7-21-50BUTT NO. F

OBJECT

Ballistic test of Guided Missile Warhead
S.A.P.-T1 B. 4" Class B Armor Plate #8443 at 20°REFERENCE N.P.G. LETTER Report No. 1092 DATED _____

PLATE

Gauge 3.75
 Class B
 Maker Midvale
 No. 8443 Group M 121
 Contract NORD 151
 Date received 26 June 1942
 Dimensions 105 3/4" X 127 1/8" X 179 1/8"
 No. of impact on plate 3
 Thickness at impact 4.06
 OBLIQUITY 20°
 Impact dimensions
 PENETRATION plate up
 Flaking front
 Flaking back
 Dist. from top, bottom
 Dist. from right, left
 Dist. from nearest impact
 Dish
 Spur
 Cracks - Bulge
 Button (Thrown)(Started)
 Through Opening

PROJECTILE

Caliber 24"
 Maker A. O. Smith
 Type Guided Missile Warhead
 Lot No. A.O.S. 19 Year of Specification
 Mark — Mod. T1 No. —
 Date received 6-8-50
 Capped or uncapped
 Weight (capped)
 Weight (uncapped) 3261. #
 Length (uncapped) 79.00
 Fuze NONE
 Filler Termicite
 Flight by screen
 Condition after firing:-
~~EFFECTIVE~~ or INEFFECTIVE
Bonnet ring broke down
in gun. Gun damaged.
Warhead struck target
plate at large yaw angle.
Warhead broken up.



BALLISTIC DATA

NOTE:	-1- Desired	-2- Oscillograph	-3- Chronograph	-4- Limit, estimated for this thickness of impact.	-5- Actual, adjusted to nominal gauge.	-6- Limit, for nominal gauge, based on this impact only. (Adjusted from column 4)	-7- Limit, for nominal gauge, established from column 6 and previous impacts.
All limits are for this plate and this obliquity only.		MEAN					
Striking velocity (f.s.)	1000	773					

REMARKS

PRESSURE: 2.8
POW: 25 MP: 76°

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Security Information

Limit shots only

e/d

F(e/d, θ)

N.P.G. Photo. No.

TABLE II
 APPENDIX B

Acceptance or Rejection recommended

WV 1111111111

Ord. No.

U. S. Navy

GUN 24" #235 TYPE A MOD. 0

File No. _____

Butt Firing

U.S. Naval Proving Ground

Dahlgren, Va. 2-13-52 194

IMPACT No. 39640

IMPACT DATE 2-13-52

BUTT No. F

OBJECT Ballistic Test of Warhead, SAP, 3000 Lb. T1 for
Matador vs. 4" Class B Armor at 20° Obliquity.

REFERENCE N.P.G. LETTER Report No. 1092 DATED _____

PLATE

Gauge 4"16
 Class B
 Maker Midvale
 No. 11715 Group M-283
 Contract Nord-5341
 Date received 22 May 1945
 Dimensions 119" x 330"
 No. of impact on plate 9
 Thickness at impact 4"06
 OBLIQUITY 20°
 Impact dimensions 23" x 48"
 PENETRATION Complete
 Flaking front 0
 Flaking back 0
 Dist. from top, ~~bottom~~ 57"
 Dist. from right, ~~left~~ 109"
 Dist. from nearest impact 35"
 Dish 6"
 Spur 10"
 Cracks - Bulge 0
 Button (Thrown) (Started)
 Through Opening 21" x 46"

PROJECTILE

Caliber 23.919
 Maker A. O. Smith
 Type Warhead
 Lot No. AOS-3 Year of Specification _____
 Mark -- Mod. -- No. 6
 Date received _____
 Gapped or uncapped _____
 Weight (capped) _____
 Weight (uncapped) 3141.0#
 Length (uncapped) 79"15
 Fuze None
 Filler Vermiculite
 Flight by screen _____
 Condition after firing:-
~~EFFECTIVE~~ or **INEFFECTIVE**
Nose section broken off at weld
Bomb body cracked open and
broken apart at weld aft. of
the ogive section -

**BALLISTIC DATA**

NOTE:	-1- Desired	-2- Oscillograph	-3- Chronograph	-4- Limit, estimated for this thickness of impact.	-5- Actual, adjusted to nominal gauge.	-6- Limit, for nominal gauge, based on this impact only. (Adjusted from column 4)	-7- Limit, for nominal gauge, established from column 6 and previous impacts.
All limits are for this plate and this obliquity only.		Mean					
Striking velocity (f.s.)		872					

REMARKS

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Acceptance or Rejection recommended

e/d. _____

TABLE II

F(e/d, θ) _____

APPENDIX B

N.P.G. Photo. No. _____

W. W. MEYERS, 1h

Ord. Eng. GS-12

1h Navy

GUN: 24" Smoothbore Type A Mod 0 #235

File No.

Butt Firing

U. S. Naval Proving Ground

Dahlgren, Va. 2-15-52 194

IMPACT NO. 39654

IMPACT DATE 2-15-52

BUTT NO. F

OBJECT Ballistic Test of Warhead, SAP, 3000 lb. T1 for Matador

REFERENCE N.P.G. LETTER *Report No. 1092* DATED

PLATE

Gauge 3"0
 Class B
 Maker Carnegie
 No. TP542 Group C751-322
 Contract -
 Date received 16 June 1945
 Dimensions 121" x 335"
 No. of impact on plate 29
 Thickness at impact 3"25
 OBLIQUITY 20°
 Impact dimensions 24" x 38"
 PENETRATION Complete
 Flaking front 0
 Flaking back 0
 Dist. from top, bottom 80"
 Dist. from right, left 146"
 Dist. from nearest impact 38"
 Dish 6"
 Spur 11"
 Cracks - Bulge 0
 Button (Thrown) (Started)
 Through Opening 22" x 33"

PROJECTILE

Caliber 23"9057
 Maker A. O. Smith
 Type Warhead
 Lot No. AOS-5 Year of Specification
 Mark -- Mod. - No. 5
 Date received -
 Capped or uncapped
 Weight (uncapped) 3014.0#
 Length (uncapped) 79"15
 Fuze None
 Filler Vermiculite
 Flight by screen
 Condition after firing:-
 EFFECTIVE or INEFFECTIVE
 Nose section broken off at
 weld - Bomb body cracked
 open to and broken open
 at weld aft of ogive.
 Section



BALLISTIC DATA

NOTE:	-1- Desired	-2- Oscillograph	-3- Chronograph	-4- Limit, estimated for this thickness of impact.	-5- Actual adjusted to nominal gauge.	-6- Limit, for nominal gauge, based on this impact only. (Adjusted from column 4)	-7- Limit, for nominal gauge, established from column 6 and previous impacts.
All limits are for this plate and this obliquity only.		Mean					
Striking velocity (f.s.)		1164					

REMARKS Wt. of Chg: 160# 9830-14" Std. Silk Bag

Used 3- 5# B. P. Boosters

Avg. Pressure 3.6 T.21

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F(e/d, θ)

N.P.G. Photo. No.

TABLE IV

APPENDIX B

Acceptance or Rejection recommended

W. W. MEYERS, 1h

Ord. Eng. GS-13

XXXXXX

GUN: 24" Smoothbore Type A Mod 0 #235

File No.

Butt Firing

U. S. Naval Proving Ground
Dahlgren, Va. 2-19-52 194IMPACT No. 39656
IMPACT DATE 2-19-52
BUTT No. F

OBJECT Ballistic Test of Matador Warhead 3000 lb. SAP T1

REFERENCE N.P.G. LETTER Letter 5-10-52 DATED 2-16-52

PLATE

Gauge 2.174
 Class STS
 Maker Carnegie
 No. X-18167 Group Bestest A-9
 Contract 448-S-1-A
 Date received June 22, 1943
 Dimensions 92-1/8" x 201-1/8"
 No. of impact on plate 3
 Thickness at impact 2.19
 OBLIQUITY 20°
 Impact dimensions 25" x 26"
 PENETRATION Complete
 Flaking front 0
 Flaking back 0
 Dist. from top, ~~bottom~~ 52"
 Dist. from ~~right~~ left 78"
 Dist. from nearest impact 43"
 Dish 5"
 Spur 9"
 Cracks - Bulge 0
 Button (Thrown) (Scattered)
 Through Opening 24" x 24-1/2"

PROJECTILE

Caliber 23.940
 Maker A. O. Smith
 Type Warhead
 Lot No. AOS-15 Year of Specification
 Mark - Mod. - No. 3
 Date received
~~Gauged~~ or uncapped
~~Weight~~ ~~uncapped~~
 Weight (uncapped) 3128.00#
 Length (uncapped) 79.15
 Fuze None
 Filler Vermiculite
 Flight by screen
 Condition after firing:-
EFFECTIVE or INEFFECTIVE
Impact - No deformation



BALLISTIC DATA

NOTE:	-1- Desired	-2- Oscillograph	-3- Chronograph	-4- Limit, estimated for this thickness of impact	-5- Actual, adjusted to nominal gauge	-6- Limit, for nominal gauge, based on this impact only. (Adjusted from column 4)	-7- Limit, for nominal gauge, established from columns 6 and previous impacts.
All limits are for this plate and this obliquity only.		Mean					
Striking velocity (f.s.)		1107					

REMARKS

Powder Charge - 150# SPDN-9830 with 3 - 5# B. P. Boosters

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N.P.G. Photo. No.

TABLE V

APPENDIX B

Acceptance or Rejection recommended

W.H. Myers

B.R. King

U.S. Navy

GUN: 24" Smoothbore Type A Mod 0 #235

File No.

Butt Firing

U. S. Naval Proving Ground

Dahlgren, Va. 2-21-52 194

IMPACT No. 39682

IMPACT DATE 2-21-52

BUTT No. F

OBJECT. Ballistic Test of Warhead SAP, 3000# T1 Matador Bomb

REFERENCE N.P.G. LETTER *Letter 57-1092* DATED

PLATE

Gauge 3 3/4
 Class B
 Maker Carnegie
 No. TT542 Group C751-322
 Contract -
 Date received 16 June 1945
 Dimensions 131" x 335"
 No. of impact on plate 30
 Thickness at impact 3 1/2"
 OBLIQUITY 0°
 Impact dimensions 24" x 24"
 PENETRATION Complete
 Flaking front 0
 Flaking back 0
 Dist. from top, ~~bottom~~ 76"
 Dist. from ~~right~~, left 64"
 Dist. from nearest impact 27"
 Dish 7"
 Spur 6"
 Cracks - Bulge 0
 Button (Thrown) (~~Started~~)
 Through Opening 22" x 23"

PROJECTILE

Caliber 23 3/4
 Maker A. O. Smith
 Type Warhead
 Lot No. AOS-6 Year of Specification
 Mark - Mod. - No. 15
 Date received -
~~Capped~~ or uncapped
~~Weight capped~~
 Weight (uncapped) 3211.00#
 Length (uncapped) 79 1/2"
 Fuze None
 Filler Vermiculite

Flight by screen
 Condition after firing:-

~~EFFECTIVE~~ or INEFFECTIVE

*Cracked over circumferentially
 ground with at nose section.
 Cracked longitudinally from
 tail to nose circumferentially
 with. Cracked after partially
 ground and circumferentially
 with.*



BALLISTIC DATA

NOTE:	-1- Desired	-2- Geodograph	-3- Chronograph	-4- Limit, estimated for this distance of impact	-5- Actual, indicated for this distance	-6- Limit, for nominal range, based on the impact only (Adjusted from column 4)	-7- Limit, for nominal range, established from column 6 and previous impacts
All limits are for this plate and this obliquity only.		Mean					
Striking velocity (f.s.)		1104					

REMARKS

Chg. 150# SPDN-9830, with 3-5# B.P. Boosters

Avg. Pressure - 3.6

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N.P.G. Photo. No.

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TABLE VI

APPENDIX B

W. W. Meyer
Card. Eng.

H. S. Navy

GUN: 24" Smoothbore, Type A Mod 0 #235

NP9-51723

13 February 1952

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SECURITY INFORMATION

Impact 39640, Warhead, SAP, 3000 lb. T1 for Matador, after impact against 4906
Class B plate at 20° obliquity and 872 ft./sec. striking velocity.
Front View

Figure 1



NP9-51724

15 February 1952

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Impact 39654, Warhead, SAP, 3000 lb. T1 for Matador, after impact against 3725
Class B plate at 20° obliquity and 1164 ft./sec. striking velocity.
Front View

Figure 2

IMP 39654



NP9-51725

19 February 1952

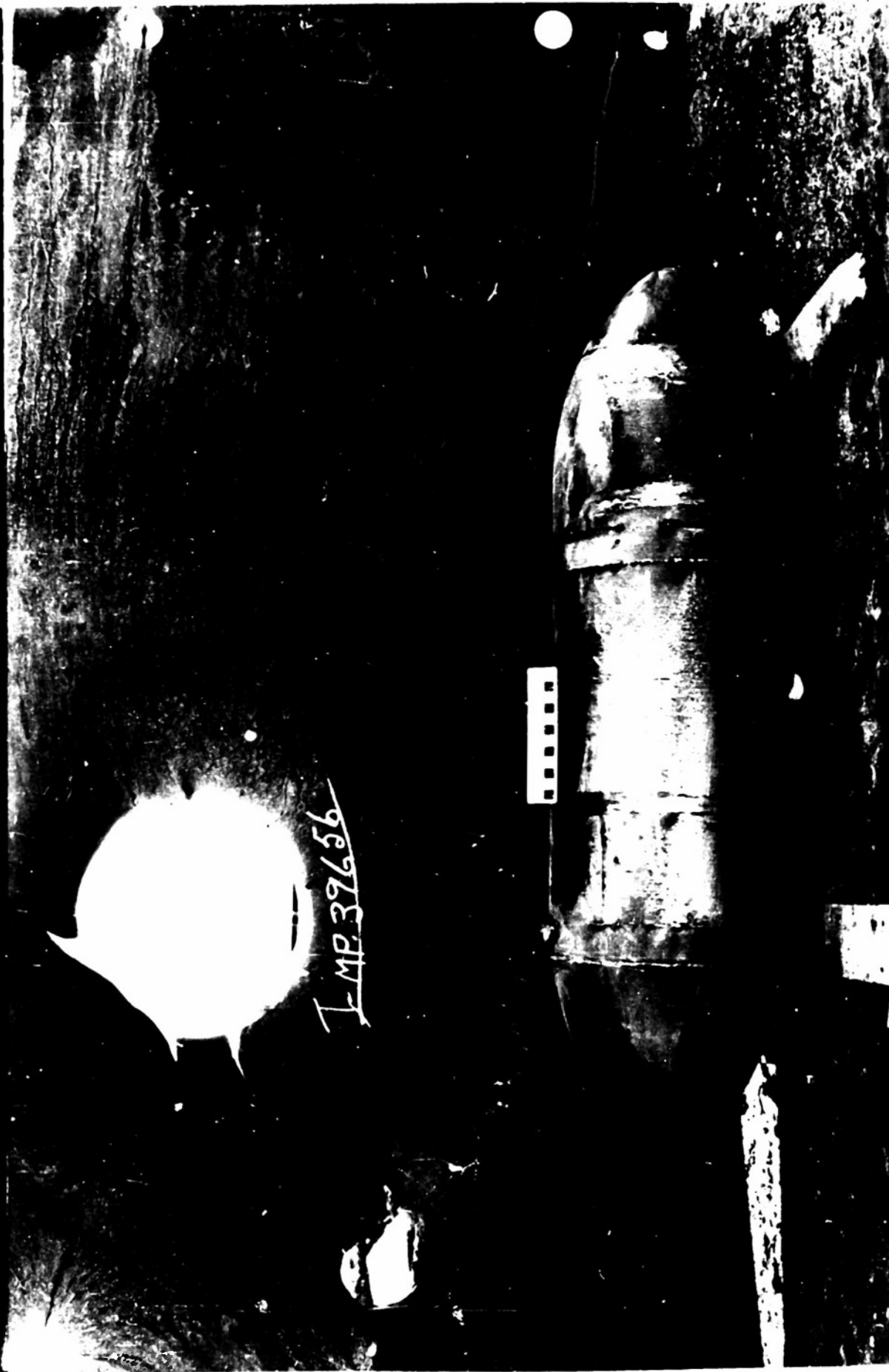
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Impact 39656, Warhead, SAP, 3000 lb. T1 for Matador, after impact against 2419
STS plate at 20° obliquity and 1107 ft./sec. striking velocity.

Front View

Figure 3



NP-51726

21 February 1952

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Impact 39682, Warhead, SAP, 3000 lb. T1 for Matador, after impact against 3825
Class B plate at 20° obliquity and 1104 ft./sec. striking velocity.
Figure 4

Front View

39682

39682



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Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. TI for Matador

DISTRIBUTION

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Gun Firing Test of Warhead
Semi Armor Piercing 3000 lb. T1 for Matador

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